Toward more effective paleolgenetic analysis

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DNA preserved in bones undergoing fossilization deteriorates up to 50 times faster when stored in a museum than when the bones are buried in the ground. This has just been shown by a paleogenetics team led by Eva-Maria Geigl (Institut Jacques Mono / CNRS – Paris). This study, which was published in the *Proceedings of the US National Academy of Sciences* 8 January 2007, shows that in order to improve the quality of paleogenetic analyses, archeological and paleontological remains should be treated like biological samples both during and after excavation.

The findings show the need for a new methodology for the excavation, treatment and preservation of fossils. They also open up new prospects for paleogenetic research into freshly excavated fossils.

In paleogenetic research, it is essential to have well-preserved archeological material in order to obtain reliable results. At present, such research is only too rarely the result of close collaboration between the various disciplines involved: molecular biologists, archeologists, paleontologists and curators.

Moreover, biologists mostly carry out such studies on samples stored in collections or in museums. However, there was no reason to suppose that the treatment carried out by fieldworkers (archeologists, paleontologists and curators), as well as storage conditions, were compatible with a paleogenetic approach. In fact, such analyses were often subject to a high failure rate, due partly to a lack of any ancient DNA detected by PCR , or to contamination by modern DNA.

An extensive study of around 250 fossil bones from 600 to 50 000 year old herbivores was carried out thanks to international cooperation between the Institut Jacques Monod at CNRS, the Museum of Natural Sciences in Madrid and a number of European, Turkish and Japanese paleontologists and archeologists. The work showed that mitochondrial DNA from freshly excavated, untreated fossil bones was amplified with a success rate of 46%. However, the rate is a mere 18% for fossil bones from collections which have been washed, dried and stored. A large part, on average 85%, of the genetic material preserved in the fossils is therefore lost as a result of treatment by archeologists and storage in museums.

These findings were confirmed by a study on fossil bones from a single animal, an aurochs which became buried 3 200 years ago in the Sarthe region of France. The fossil bones were excavated during two excavation campaigns, the first carried out in 1947, and the second in 2004. Convinced by Geigl that it was necessary to analyze freshly excavated fossil bones, Nicolas Morel, a paleontologist and curator of the Musée Vert in Le Mans looked up the location of the site of the 1947 excavation in the records, and then collected an extra 120 freshly excavated fossil bones from the aurochs. None of the fossil bones excavated in 1947 and stored in the Musée Vert yielded any results from paleogenetic analysis.

On the other hand, DNA amplification was obtained with all the 2004 fossil bones, thus yielding significant results from paleogenetic analysis. Another finding revealed by this study was that the DNA had deteriorated as much in 57 years as during the previous two thousand years of burial. A rise in temperature and a fall in pH and salt concentration as a result of being washed are the main factors put forward in order to explain the increasingly rapid deterioration of the DNA taken from treated bones.

An interdisciplinary approach involving close collaboration between molecular biologists and fieldworkers led to this important discovery. This opens up the prospect of more extensive paleogenetic analyses, regarding both the length of the time periods that can be analyzed as well as the variety of questions that can be tackled.

This is because until now information has mainly been obtained from samples from cold regions, since DNA is better preserved at low temperatures. By analyzing freshly excavated fossil material, it should be possible to recover genetic information from specimens from warm or temperate regions such as the Middle East and Africa, regions where there is potentially a wealth of information about the development of our civilization and about human evolution.

Source: CNRS

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